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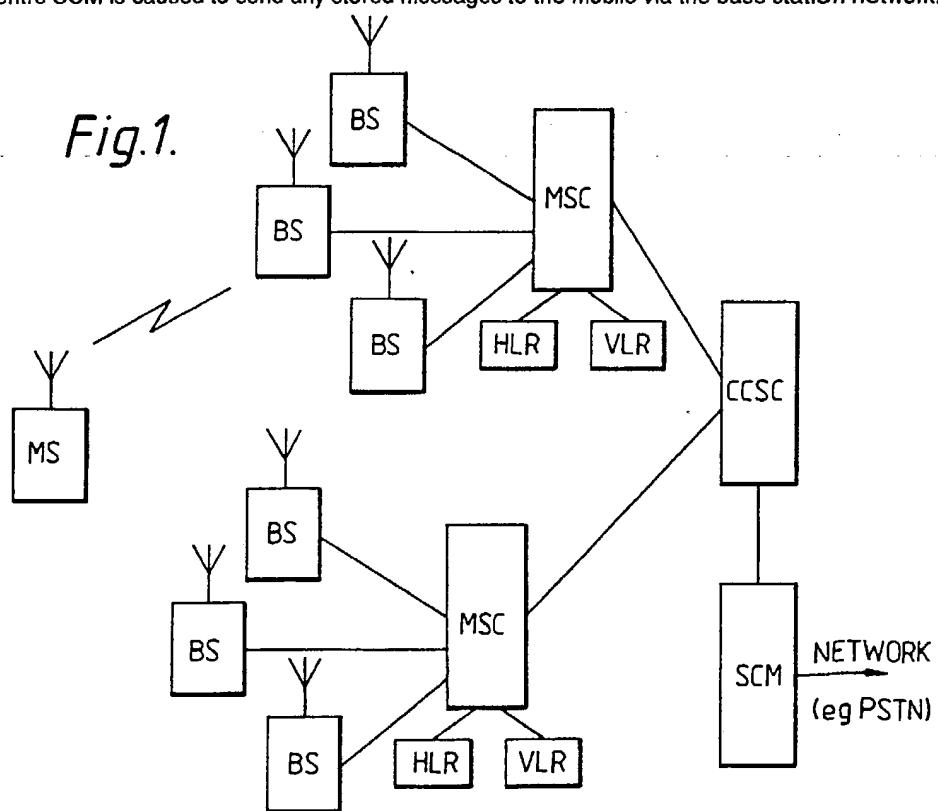
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## (54) Mobile radio communication system

(57) A radio communications system, particularly a cellular system, has base stations BS for providing a bi-directional radio communication link with a mobile station MS. A messaging centre SCM is connected to the base stations for storing an incoming message for forwarding to a mobile station using the system. Each mobile station MS has a timer, and during a low power consumption "off" state of the mobile, the timer periodically switches the mobile to an on state to effect a location registration update communication procedure with the base station network. In response to this communication, the messaging centre SCM is caused to send any stored messages to the mobile via the base station network.

Fig.1.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig.1.

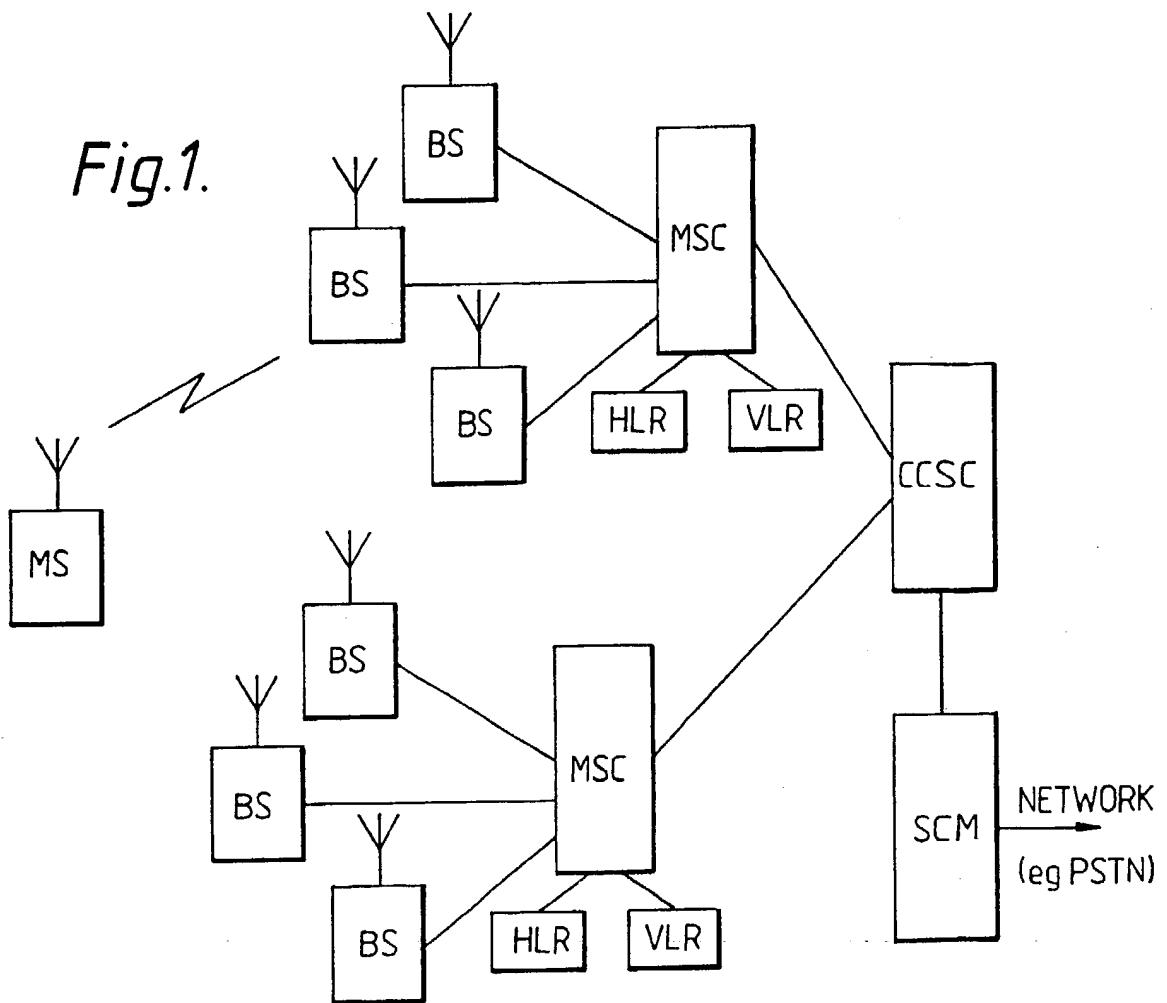


Fig.2.

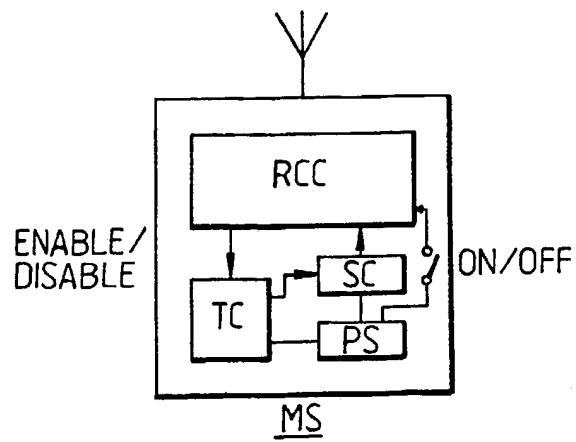


Fig. 3A.

## SIGNALLING ASSOCIATED WITH SMS

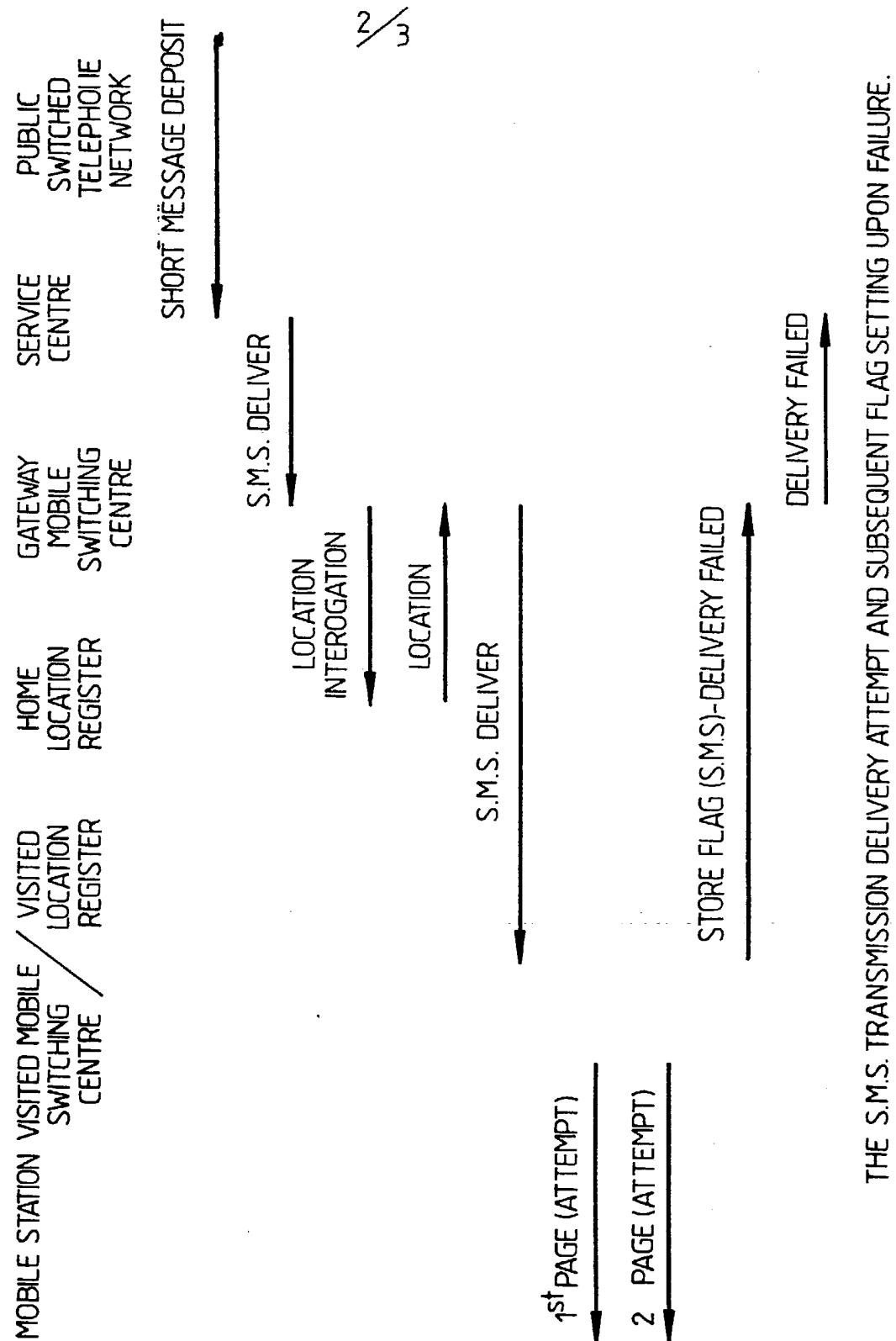
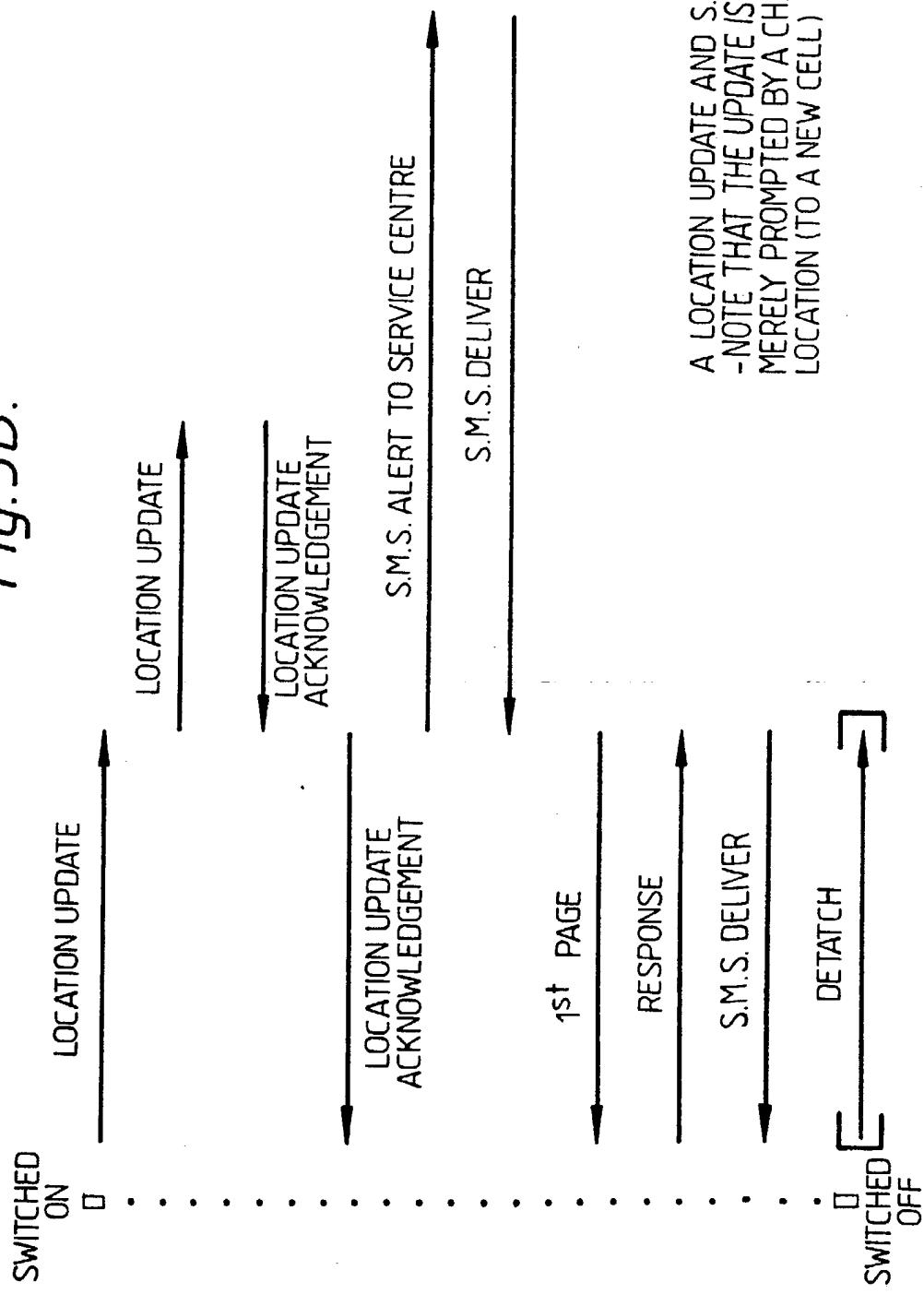


Fig. 3B.



## RADIO COMMUNICATION SYSTEM

The present invention relates to a radio communications system, and in particular, though not exclusively, to a cellular radio system.

One of the major advantages of cellular radio system is that mobile stations, which may be hand portable units, can be contacted at any time. At any time that is provided the mobile station is switched on and has registered with the cellular network. In existing cellular systems, for example UK's TACS system, the cellular system has primarily been able to deliver only calls to a mobile, and not data or text messages. In the proposed GSM, Pan-European digital cellular radio system, in addition to connecting calls to a mobile station, provision can be made for sending data and text messages - the short message services (SMS). A user will be able, for example, to receive an SMS message during a meeting rather than receiving a call or leaving the handset off to avoid such disturbance. The switching off of mobile stations, and in particular hand portables, to extend battery life or for privacy, is a significant problem. Many calls under the existing TACS system fail for this reason, and it must be envisaged that calls and SMS messaging under GSM must also be highly likely to fail for the same reason.

The present invention is concerned with promoting the delivery of messages, as distinct from calls to mobile units in a cellular radio system.

According to a first aspect the invention provides a radio communications system comprising: a base station for providing a bi-directional radio communication link with a mobile station; a messaging centre, connected to the base station, for storing an incoming message for forwarding to a mobile station using the system; a mobile station having timer means for periodically initiating communication with the base station, so that an incoming stored message can be forwarded via the base station network to the mobile station.

According to the invention a cellular radio system is provided comprising a network of base stations for providing a bi-directional radio communications link with a mobile station; a messaging centre connected to the base station network for storing an incoming message for forwarding to a mobile station using the system; a mobile station having timer means for periodically switching the mobile station from a lower power consumption, "off" state to a higher power consumption, "on" state for a predetermined period, and means for initiating signalling with the base station network during the predetermined period, so that an incoming stored message can be forwarded via the base station network to the mobile station.

The messaging may be voice messaging e.g. a recorded announcement or a digital stored voice message, but is preferable text messaging of the GSM SMS-type. The predetermined period for which the mobile is on may be set to be sufficient to receive one or more messages, but preferably the period is extendable upon receipt by the mobile station of a command signal from the base station network. The predetermined period may be set to be sufficient just to receive such a command signal, thus minimising the "on" time of the mobile station. The period of the timer i.e. the period during which the

mobile station is "off", may be adjustable, either by a user at the mobile station or by a command signal from the network. The mobile station may be switchable between two (or more) modes with differing time periods, for example a night mode and a day mode with the timer (off) period being greater in the night mode than in the day mode. Again the switching between modes may be done by a user at the mobile station or under command from the network. The mobile station may have an alarm which can be activated when a message is received.

By provision of a low power mode the battery life of the mobile station is extended while still maintaining a periodic link with the network, which can be sufficient for some user requirements. The sender of a message or a caller using a voice messaging service, knows that provided that the mobile station is at least in the lower power state, the mobile station, and hence the user, will receive the message within a period of time.

In further enhancements, the system could store details of the latest registration of a mobile, including the time of the latest registrations and period between registrations. The system, on receipt of an incoming message for a mobile, could check to see the stored details from the latest registration and make a decision on the delivery of the message. Delivery could be attempted immediately, deferred until the next expected registration, or could be abandoned. A suitable message could be returned to the sender of the message, indicating for example, that delivery would be attempted at the next expected registration which would be at such-and-such a time. Messages indicating other circumstances could likewise be sent to the sender of a message. Similarly, when a message is delivered to a mobile user, details of the original time of receipt could be included and also an indication of any acknowledgement provided to the sender by the system.

It is possible to envisage that the form of the delivery attempt procedure could be adapted to the circumstances for a particular delivery attempt. For example, if it was believed a mobile was switched off, a limited delivery attempt could be made - just in case the mobile was switched on - whereas if the mobile was expected to be on, a fuller delivery attempt could be made. Periodically repeated delivery attempts can also be envisaged.

A preferred embodiment of the invention will now be described by way of example, and with reference to the accompanying drawings, wherever:-

Figure 1 is a general schematic diagram of a cellular radio system according to a preferred embodiment of the invention;

Figure 2 is a schematic diagram of a mobile station of a preferred embodiment of the invention; and

Figure 3 is a chart showing signal and message transfer in a preferred embodiment of the invention.

In a preferred embodiment a cellular radio system for serving one or more mobile stations has a base station network with a number of Base stations (BS) linked in groups to mobile switching centres (MSCs) which centres are linked to a central control and switching centre (CCSC) which may also be a mobile switching centre. A service centre for messaging (SCM) is connected on the one hand to a network, e.g. a PSTN, for receiving incoming messages and on the other hand to the central control and switching centre (CCSC). Each mobile switching centre (MSC) has a home location register (HLR) which stores the current location of each mobile station associated with that mobile switching centre; i.e. details of the current mobile switching centre with which the mobile has registered; and a visited location register (VLR) which

stores the details of mobile stations associated with other mobile switching centres, but currently registered with that mobile switching centre. The cellular radio system as illustrated is in general conformance with the GSM, Pan-European Cellular Radio standard. Such a cellular radio system can handle the short messaging service identified in the GSM standard.

In the GSM - SMS service, as shown in Figure 3A, a short message is deposited in the service centre (SCM) and delivery of the message is attempted. This attempt involves the central control and switching centre (CCSC) checking with the home location register of the mobile station to which the message is addressed, to establish the current location of the addressed mobile station. The central control and switching centre (CCSC) then delivers the short message to the mobile switching centre (MSC) through which the mobile station (MS) should be contactable. The mobile switching centre (MSC) pages the mobile station (MS). If the mobile station (MS) receives the paging signal, a communications link can be established and the short message delivered to the mobile station. The message may not be delivered however because, for example, the mobile station may be switched off and unable to receive and respond to the paging signal, and may indeed have passed into part of the network overseen by another mobile switching centre.

In the preferred embodiment of the invention, a mobile station portable handset has, in addition to radio communications circuitry (RCC) and a power supply (PS), timer circuitry (TC) powered either from power supply (PS), as illustrated, or from an independent power supply. The timer circuit (TC) is connected to switching circuit (SC) for connecting/disconnecting the power supply (PS) to/from the radio communications circuitry (RCC).

The radio communications circuitry (RCC) has a connection to the timer circuitry (TC), so that timer circuitry (TC) can be over-ridden. The mobile station has an ON/OFF switch for normal usage.

It is intended that a user can switch the handset "ON" and operate the handset in the usual way. The operation of timer circuitry which will be described below, is over-ridden while the handset is "ON". When the handset is switched "ON" an automatic registration procedure is attempted, which if successful will result in the 'home' mobile switching centre (MSC) storing in its home location register (HLR) the current location of the handset (MS). While the handset remains "ON", short messages can be delivered in the way previously described.

When a user switches "OFF" the handset of the preferred embodiment, the overriding of the operation of the timer circuitry (TC) ceases. The timer circuitry then periodically e.g. every half hour, connects the power supply (PS) to the radio communications circuitry (RCC) by means of the switching circuitry (SC). The radio communications circuitry (RCC) initiates a registration procedure which notifies the base station network, if, of course, the handset is communications range, of the presence of the handset (MS) and the Home location register of the handset is updated. This procedure is shown in Figure 3B. The mobile switching centre (MSC) alerts the service centre to the temporary availability of the handset (MS). The service centre stores any previously unsuccessfully delivered short messages and on receipt of the handset availability signal, sends any stored messages to the mobile switching centre. If a short message is sent to the mobile switching centre, the mobile switching makes a paging attempt to the handset (MS). At the handset (MS), timer circuitry (TC)

maintains the radio communications circuitry (RCC) "ON" for sufficient time to receive any paging attempt. When a paging signal is received by the handset (MS), the radio communications circuitry (RCC) disables the timer circuitry (TC) and responds to the paging attempt. The mobile switching centre (MSC) delivers the short message to the handset (MS). The handset (MS) detaches itself once the short message(s) have been delivered and the radio communications circuitry (RCC) then enables the timer circuitry (TC). The timer circuitry (TC) then operates the switching circuitry (SC) to disconnect the power supply (PS) from the radio communications circuitry (RCC). The timer circuitry (TC) then operates as described above to reconnect the power supply (PS) to the radio communications circuitry and thereby initiate a registration attempt after the predetermined period, e.g. half an hour.

It will be appreciated that the timer circuitry (TC) has two cyclic predetermined periods of operation, one is an "OFF" period, i.e. when the radio communications circuitry (RCC) is not powered, and the other is an "ON" period when conversely the radio communications circuitry (RCC) is powered. The timer circuitry (TC) can be disabled during the "ON" period by the radio communications circuitry (RCC) to allow for reception of one or more short messages and when enabled after reception of such messages, the timer circuitry resumes and completes the "ON" period.

Various modifications to the preferred embodiment can be envisaged within the scope of the invention including, for example, the provision in the handset (MS) of a common ON/OFF switch for the radio communications circuitry and the timer circuitry so that while one is "ON" the other is "OFF". Also, for example, completion of receipt of a

short message by the handset may cause a reset of the timer circuitry (TC) so that an "OFF" period immediately commences, rather than continuation and completion of the "ON" period.

CLAIMS

1. A radio communications system comprising: a base station for providing a bi-directional radio communication link with a mobile station; a messaging centre, connected to the base station, for storing an incoming message for forwarding to a mobile station using the system; a mobile station having timer means for periodically initiating communication with the base station, so that an incoming stored message can be forwarded via the base station network to the mobile station.
2. A cellular radio system comprising: a network of base stations for providing a bi-directional radio communication link with a mobile station; a messaging centre, connected to the base station, for storing an incoming message for forwarding to a mobile station using the system; a mobile station having timer means for periodically switching the mobile station from a lower power consumption, "off" state to a higher power consumption, "on" state for a predetermined period, and means for initiating signalling with the base station network during the predetermined period, so that an incoming stored message can be forwarded via the base station network to the mobile station.
3. A cellular radio system as described in claim 2 wherein the base station network has means for transmitting a signal, for maintaining the mobile station in the "ON" state beyond the predetermined period, to allow for delivery of the message, and the mobile station has means for responding to the message.
4. A cellular radio system as described in claim 1 or 2 or 3 wherein the messaging is text messaging.

5. A cellular radio system as described in claim 1 or 2 or 3 wherein the message is voice messaging.
6. A cellular radio system as claimed in any preceding claim wherein the period of the timer means is adjustable.
7. A cellular radio system as claimed in claim 6 wherein the period of the timer means can be set by a command signal from the base station network.
8. A cellular radio system as claimed in any preceding claim, wherein the mobile has means for switching between two or more modes, with differing timer periods.
9. A cellular radio system as claimed in claim 8 wherein the mobile station has means for switching between modes under a command signal from the base station network.
10. A cellular radio system as claimed in any preceding claim wherein the mobile station has alarm means activatable upon receipt of a message.
11. A mobile station for a cellular radio system, as claimed in any preceding claim.
12. A messaging centre for a cellular radio system as claimed in any preceding claim.
13. A base station network for a cellular radio system, as claimed in any preceding claim.
14. A cellular radio system substantially as herein described, and with reference to the accompanying drawings.

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